

CLAIMS

- 1 1. A system for replay of a backup memory in a storage system having a file system
2 for managing transfer of data to and from an attached disk array, the system comprising:
3 a log in the backup memory containing storage system transaction entries accu-
4 mulated after a consistency point at which time results of the transaction entries are
5 committed to the disk array;
6 an initiator process that establishes a swarm of messages with respect to the trans-
7 action request entries and delivers the swarm to the file system; and
8 a disk information-retrieval process in the file system that is carried out on the
9 swarm of messages in parallel.
- 1 2. The system as set forth in claim 1 wherein each of the messages of the swarm is
2 identified by a transaction block including a pointer to one of the transaction request en-
3 tries in the log, respectively, and a state that indicates whether each of the messages is
4 one of (a) newly transferred to the file system, (b) subject to completion of a LOAD
5 phase thereon by the disk information-retrieval process, (c) subject to completion of a
6 MODIFY phase thereon by a MODIFY process of the file system or (d) incapable of be-
7 ing subject to the LOAD phase until a prerequisite event occurs.
- 1 3. The system as set forth in claim 2 wherein the prerequisite event is completion of
2 the LOAD phase and a MODIFY phase with respect to another of the messages.
- 1 4. The system as set forth in claim 3 wherein the initiator process is adapted to
2 retransfer each of the messages incapable of being subject to a load phase until the pre-
3 requisite event occurs to the file system for completion of the LOAD phase after the pre-
4 requisite event occurs, respectively.
- 1 5. The system as set forth in claim 4 wherein the initiator is adapted to establish a
2 skip state with respect to skipped messages for which a portion of the disk array associ-

3 ated therewith is unavailable, the skip state thereby omitting the skipped messages from
✓ 4 the swarm.

✓ 1 6. The system as set forth in claim 4 wherein the file system includes a panic state
2 adapted to alert an operator if a first message received from the initiator in the swarm is a
3 message incapable of being subject to a load phase until a prerequisite event occurs.

✓ 1 7. The system as set forth in claim 4 wherein the file system includes a panic state
2 adapted to alert an operator if a message retransferred by the initiator process is a mes-
3 sage incapable of being subject to a load phase until a prerequisite event occurs.

✓ 1 8. The system as set forth in claim 1 wherein the backup memory comprises a non-
2 volatile random access memory (NVRAM).

✓ 1 9. The system as set forth in claim 1 wherein the storage system comprises a net-
2 work storage appliance.

✓ 1 10. A method for replay of a backup memory in a storage system having a file system
2 for managing transfer of data to and from an attached disk array, the method comprising:
3 accumulating, in a log in the backup memory, storage system transaction request
4 entries after a consistency point at which time results of the transaction request entries are
5 committed to the disk array;
6 establishing a swarm of messages with respect to the transaction request entries
7 and delivering the swarm to the file system; and
8 performing a disk information-retrieval process of the file system on the swarm of
9 messages in parallel.

✓ 1 11. The method as set forth in claim 10 further comprising establishing, for each of
2 the messages of the swarm, a transaction block including a pointer to one of the transac-
3 tion request entries in the log, respectively, and a state that indicates whether each of the
4 messages is one of (a) newly transferred to the file system, (b) subject to completion of a

5 LOAD phase thereon by the disk information-retrieval process, (c) subject to completion
6 of a MODIFY phase thereon by a MODIFY process of the file system or (d) incapable of
7 being subject to the LOAD phase until a prerequisite event occurs.

✓ 1 12. The method as set forth in claim 11 wherein the prerequisite event is completion
2 of the LOAD phase and a MODIFY phase with respect to another of the messages.

✓ 1 13. The method as set forth in claim 12 further comprising retransferring each of the
2 messages incapable of being subject to a load phase until the prerequisite event occurs to
3 the file system for completion of the LOAD phase after the prerequisite event occurs, re-
4 spectively.

✓ 1 14. The method as set forth in claim 10 wherein the storage system comprises a net-
2 work storage appliance.

✓ 1 15. A computer-readable medium including program instructions executing on a
2 computer for parallelized replay of a backup memory in a storage system having a file
3 system for managing transfer of data to and from an attached disk array, the program in-
4 structions performing the steps of:
5 accumulating, in a log in the backup memory, storage system transaction request
6 entries after a consistency point at which results of the transaction request entries are
7 committed to the disk array;
8 establishing a swarm of messages with respect to the transaction request entries
9 and delivering the swarm to the file system; and
10 performing a disk information-retrieval process of the file system on the swarm of
11 messages in parallel.

✓ 1 16. The computer-readable medium as set forth in claim 15 further comprising estab-
2 lishing, for each of the messages of the swarm, a transaction block including a pointer to
3 one of the transaction request entries in the log, respectively, in the log and a state that
4 indicates whether each of the messages is one of (a) newly transferred to the file system,

5 (b) subject to completion of the LOAD phase thereon by the disk information-retrieval
6 process, (c) subject to completion of a MODIFY phase thereon by a MODIFY process of
7 the file system or (d) incapable of being subject to the LOAD phase until a prerequisite
8 event occurs.

✓ 17. The computer-readable medium as set forth in claim 16 wherein the prerequisite
2 event is completion of the LOAD phase and a MODIFY phase with respect to another of
3 the messages.

✓ 18. The computer-readable medium as set forth in claim 17 further comprising re-
2 transferring each of the messages incapable of being subject to a load phase until the pre-
3 requisite event occurs to the file system for completion of the LOAD phase after the pre-
4 requisite event occurs, respectively.

✓ 19. The computer-readable medium as set forth in claim 15 wherein the storage sys-
2 tem comprises a network storage appliance.